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ABSTRACT

This student manual is designed to introduce students to topographic maps and compass use. The first of five units included in the manual is an introduction to topographic maps. Among the topics discussed in this unit are uses, sources, and care and maintenance of topographic maps. Unit 2 discusses topographic map symbols and colors and provides a student exercise relating to map symbols. Unit 3, Topographic Map Interpretation, covers topics such as reading directions from a topographic map, latitude and longitude, and elevation. This unit also contains four student exercises relating to map interpretation. The fourth unit provides an introduction to the orienteering compass and provides two student exercises involving naming directions and avoiding obstacles. The final unit explains how to travel by map and compass and gives a student exercise on taking bearings on a topographic map. A topographic map symbol sheet is appended. (LRA)

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STUDENT MANUAL

Topographic Map & Compass Use

By Michael Taylor

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A full-color topographic map symbol sheet can be found in the pocket on the inside back cover.

Introduction to Topographic Maps

At the completion of this unit, the student will be able to:

1. **Write the definition of a map.**
2. **List four different types of maps.**
3. **Write the definition of topographic map.**
4. **List two ways topographic maps can be used as tools in natural resources.**
5. **List two sources for acquiring topographic maps.**
6. **Describe how a topographic map can be located and named using the topographic index map for his/her state.**
7. **List two methods currently used to make topographic maps.**
8. **List and follow two methods of protecting the topographic map from the elements while in the out of doors.**
9. **Fold a topographic map properly.**
10. **Define uses of ten kinds of marginal information from a topographic map:**
    - **map name**
    - **scale**
    - **bar scales**
    - **credit note**
    - **declination diagram**
    - **contour interval**
    - **road classification**
    - **adjoining quadrangles**
    - **latitude and longitude**

The purpose of this unit is to introduce you to maps, specifically the **topographic map.** The topographic map is useful for outdoor work and recreational activities involving travel. It is also an invaluable tool in the construction trades, conservation-related projects, and recreational activities such as hunting, fishing, and camping. Knowledge of topographic maps not only assures good land-planning practices, but also gives the outdoor-oriented person new confidence.

New avenues of travel open up to those who develop topographic map-reading skills. With a map, you may find that hidden trout stream, perfect hunting spot, or simply peace and quiet away from the backpacking trails (which are becoming more like highways every day). People who learn to read topographic maps can guide themselves to these otherwise remote areas. They get where they want to go rather than get lost.

What is a map?

A map is a visual representation, or picture, on paper of a section of the earth's surface. The word "map" comes from a word that the ancient Romans used for "napkin." Apparently many military strategies were actually mapped, that is sketched, on napkins over lunch or dinner feasts during Roman times.

There are many types of maps, each with its own particular use. Some types, like the road map, are used in everyday life. Other types, such as soil maps, geology maps, weather maps, political maps, tax maps, and topographic maps, are not so commonly used.

Road maps are made for travelers to use. They show the location of villages, towns, cities, and their connecting roads. Accurate directions and distances may be given, along with road type and other information useful to the traveler.

A topographic map is a line and symbol representation of natural features (such as rivers and hills) and cultural features (such as roads and cities) found on a part of the earth's surface. These features are plotted to a definite scale. Using **contour lines**, the topographic map shows elevations above sea level. The shape of the land (valleys, hills) can be visualized by the map reader. Contour lines will be discussed in Unit 3.

Uses of topographic maps

Topographic maps allow the reader to determine the slope of the land, what vegetation is present, and the drainage conditions of an area. This information is important in construction and conservation projects. For example, one must know the drainage conditions and slope of an area before even considering the construction of any building. A topographic map allows the reader to determine these conditions and identify potential problems without having to visit the area.

In addition to their use in construction and conservation projects, topographic maps are also important to people who hunt and fish and to others in outdoor work and recreation.

Maps are a useful tool in planning trips through rural and wilderness areas. The leader of a camping trip should be experienced in reading the topographic map to guide a party safely through unknown territory. A topographic map is, in effect, a "road map" of rural and wilderness areas.

Sources of topographic maps

Topographic maps can be bought at many places. To purchase a map, you must be able to identify the map you need.

In New York State, maps are available from the:

New York State College of
Agriculture and Life Sciences
Department of Natural Resources
Cornell University
Ithaca, NY 14853

The land area represented by a topographic map is called the **topographic quadrangle.** Each topographic quadrangle is named for one of its outstanding physical or cultural features. When possible, the map is named after the largest city shown on the map, such as the "Victor Quandrangle." A map may be named for a natural feature such as "Canandaigua Lake Quadrangle."

To find the name of the topographic quadrangle that you need, look in the **index** for the appropriate section of the country. Indexes identify the different topographic maps of a region, such as the Eastern United States. Indexes also contain lists of special maps, addresses of local map reference libraries, local map dealers, and federal map distribution centers. An order blank with instructions for ordering maps is supplied with each index. Indexes can be obtained free of charge by writing to:

Branch of Distribution
U.S. Geological Survey
1200 South Eads St.
Arlington, VA 22202

The topographic index of your state is another specialized map. It shows the topographic maps of the state by name, date, and scale. To find the map needed, simply locate the area of interest and read the name of the quadrangle making up that area. Then buy the topographic map by the name. Your area of interest may extend beyond the boundaries covered by one topographic map; in that case, maps for adjoining areas must be purchased.

How maps are made

A question that is often asked about topographic maps is, "How are they made?" In the past, map making or cartography was done from the memory and field sketches of travelers. Map making in these early years involved the wild imaginations of weary and superstitious travelers. The resulting maps were often beautiful pictorial accounts of the locations of sea monsters, mermaids, and the edge of the earth. Of course, such maps weren't very accurate.

Today, maps are made by using precise methods. Cameras in airplanes flying thousands of feet above ground take a series of overlapping photographs (see figure 1–1). These aerial photographs are then viewed through stereoscopic instruments from which contours, woodlands, drainage, and cultural features (such as houses, barns, roads, and schools) can be seen and drawn on paper to make a topographic map. Also, field surveys are used to verify the locations of political boundaries, public lands and private lands, buildings, roads, lakes, rivers, and streams. Pictures from satellites are also used to measure accuracy.

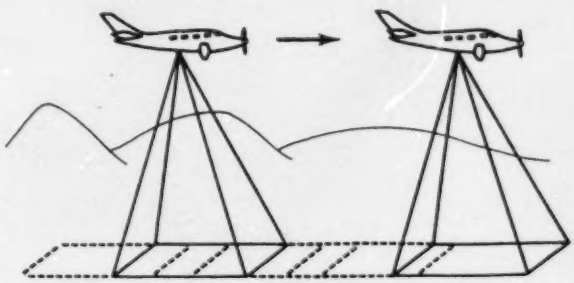


Figure 1–1. Airplanes taking overlapping pictures to make maps.

Anyone who has been given incorrect directions or a poorly drawn map knows too well the importance of accurate maps. Since topographic maps are made by aerial photography, surveys, and field inspection, they are very accurate.

Care and maintenance of topographic maps

Topographic maps are important to people for survival in wilderness areas. Imagine a mountaineering expedition to an area when the topographic map couldn't be read because it had been rained on. The party becomes lost and stumbles about for hours trying to locate their camp in near-freezing temperatures. If lost for too long in those conditions, the people can die. This life and death situation never would have occurred if the map had been protected from the rain.

To protect topographic maps from dirt, rain, and snow, they should be put in special waterproof map bags. The bags are made of clear plastic so that the map can be read without taking it out of the bag. Good, low-cost substitutes for map bags are self-locking freezer bags available in most food stores. These bags should be purchased in at least the 10" x 11" size.

It is also important that topographic maps are folded properly to make them easy to read in the field and last longer. See figure 1–2 for the correct way to fold topographic maps. Practice folding a sheet of paper in this manner.

(To fit a topographic map in a self-locking bag, the map must be folded again into thirds. The map area being used should face outwards.)

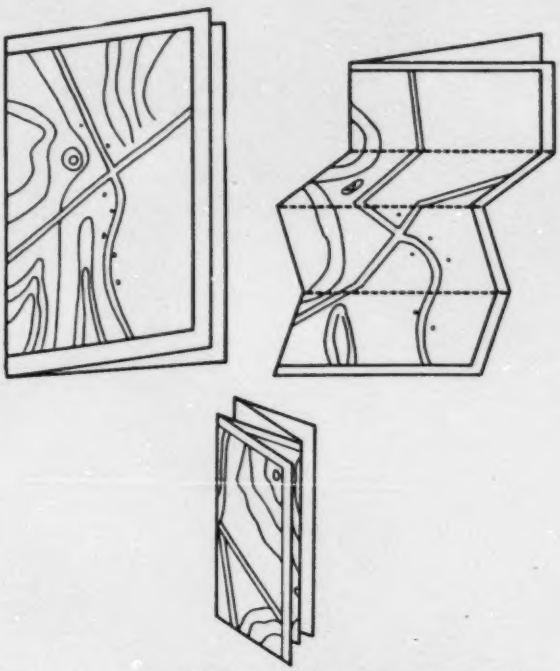


Figure 1–2. Three steps to properly fold a topographic map.

Map margin information

Before operating any piece of heavy equipment, the operator should read the instruction manual carefully. Neglecting to do so puts the operator's health and life in jeopardy. Similarly, since all maps are not the same, the instructions for every map should be carefully read and understood before heading into new areas.

Instructions for using topographic maps are found in the map margin—the white border outside the thin black line surrounding the map body. This thin black line is called the "neat line."

A topographic map reader must be able to define and use ten kinds of margin information. Figure 1–3 shows a sample map with a numbered key that identifies the margin information.

The **map name** is found in the upper and lower right-hand margins. Included below the map name is the year the map was printed. The year tells you if the map is up to date. For example, a map printed in 1943 would not show current cultural features, such as houses, buildings, roads, or physical changes in such features as farmlands, woodlands, and water. If using an outdated topographic map, the reader must be aware of cultural and physical changes that might have occurred since it was made.

The **map scale** indicates the ratio of map size to the corresponding distance on the earth's surface. For example, a scale of 1: 24,000 indicates 1 inch on the map equals 24,000 inches on the earth's surface. Map scale will be explained more fully in Unit 3.

Bar scales are rulers on the map used to convert map distance to actual ground distance. Scales are given in miles, feet, kilometers (so you can measure in different units) and in fractions (so you can measure less than full units). The bar scales are found in the lower central margin below the map scale.

The **credit note** is found in the lower left-hand margin of the map. This note tells you about the reliability of the map by indicating when and how the information used to make the map was obtained. For example, the cultural and drainage features of a map were compiled by the Army Corps of Engineers.

The **declination diagram** is located in the lower left-hand margin. This information shows the angular relationships of the lines indicating true north, grid north, and magnetic north. These terms are explained in Unit 5.

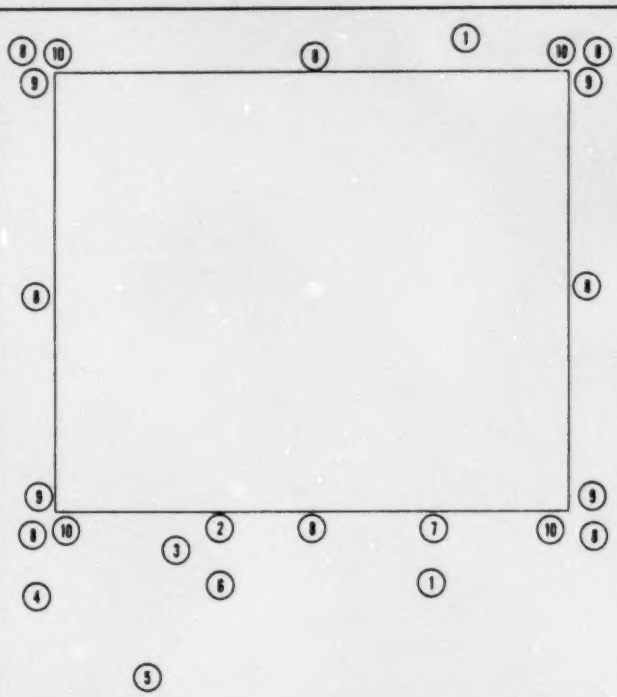


Figure 1–3. Key to map margin information.

1. **Map name**
2. **Map scale**
3. **Bar scales**
4. **Credit note**
5. **Declination diagram**
6. **Contour interval**
7. **Road classifications**
8. **Adjoining quadrangles (maps)**
9. **Latitude**
10. **Longitude**

The **contour interval** appears at the center of the lower margin. It indicates the vertical distance between contour lines, such as 100 feet. Unit 3 explains contour interval further.

The **road classification** note appears in the lower right-hand margin above the map name. It is used to identify roads by size (two- or four-lane) and kind of surface (paved or gravel). It also gives the symbols for U.S. and state roads.

Along the neat line, maps are listed by name as they are located in relation to this map. This information identifies the **adjoining maps (quadrangles)** for trips that involve more than one map. It is sometimes necessary to make larger "regional" topographic maps by piecing together several adjacent maps.

Latitude and **longitude** tick marks are found at the map corners and along the neat line. These numbers refer to the coordinate system used to locate this map on the earth's grid system. Lines of latitude run east and west. Lines of longitude run north and south. These lines, which you can see on a globe of the world, are used in navigation. Latitude and longitude will be discussed further in Unit 3.

Topographic Map Symbols and Colors

At the completion of this unit, the student will be able to:

1. **Define the term topographic symbol.**
2. **State one reason why topographic symbols are not in proportion to map scale.**
3. **List and state the meaning of the six colors in the color code used for topographic symbols.**
4. **Label topographic symbols by name on a topographic map.**

A map helps the reader to locate an area of the earth's surface and the important features within the area. Ideally, every feature should be shown on the map in its proper size, location, and shape. This may not be practical because some features are unimportant and others would be much too small to be seen by the reader. For this reason, map makers use symbols to represent natural and cultural features.

Topographic symbols are printed in different colors to make identification easier for the map reader. The colors provide a natural appearance and contrast. The following color code is used to classify topographic map features:

BLACK—Identifies the majority of **cultural features** such as houses, barns, schools, churches, pipelines, transmission lines, and railroad tracks

BLUE—Identifies **water features** such as rivers, lakes, swamps, and marshes

GREEN—Identifies **vegetation** such as woodlands, orchards, and vineyards

BROWN—Identifies **elevation** features (contour lines)

RED—Identifies main roads, special features, and heavily populated areas

WHITE—Identifies **open areas** such as cultivated land or meadows

In the map-making process, all features must be reduced proportionately to map scale. Map symbols, however, are exaggerated in scale (size) to be large enough to be seen. For example, on a 1:24,000 scale, by measuring the map symbol, road widths can be computed to be 60 feet. Actually, the road width is nearer to 30 feet. By certain map scales, forest ranger stations would be taller than 400 feet and railroad tracks over 75 feet wide. The smaller the map scale, the more exaggerated the size of the symbols. Even though the symbols are exaggerated in size, the true position of the center of the feature is maintained to preserve its accurate location on the map. Remember: the main purpose of a map is to allow the reader to **locate** a feature.

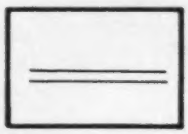
When traveling in a foreign country, it is important to know the language of that country. Map symbols are the "language" of topographic maps; therefore, to read topographic maps effectively and determine your position, you must know what the symbols mean. For example, if the map reader can identify such landmarks as rock quarries, ponds, streams, and cemeteries through the knowledge of map symbols, an accurate location of these features can be pin-pointed on the map.

A list of topographic map symbols is provided. After studying the topographic symbols, complete Exercise 1, "Identifying Topographic Symbols" on page 6.

Identifying topographic map symbols

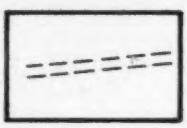
Name _____

In the space provided next to each topographic map symbol, write the name of the symbol shown in the box.



1. _____

2. _____



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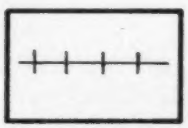

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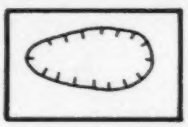

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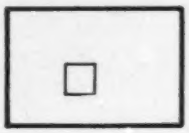

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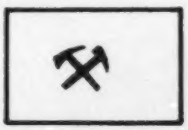

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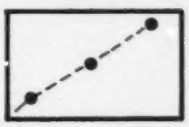

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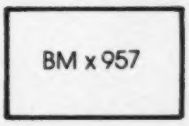

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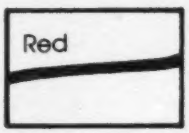

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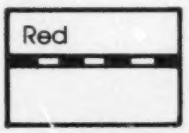

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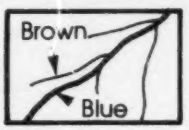
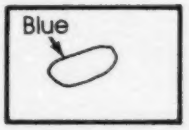


18. _____



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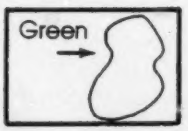


20. _____

Topographic Map Interpretation

At the completion of this unit, the student will be able to:

1. **Locate and name the eight principal directions on a topographic map.**
2. **Define latitude and longitude.**
3. **State why the area covered by topographic quadrangles decreases as you travel north or south from the equator.**
4. **Define topographic map series (7.5-minute series and 15-minute series).**
5. **Define map scale.**
6. **List the two most common topographic map scales used by people in the out-of-doors and the size of the area covered by each.**
7. **List the major uses for maps with scales of 1:24,000 and 1:62,500.**
8. **Measure the straight-line distance between any two points on a given topographic map using the bar scale and a piece of paper.**
9. **Measure curved line distance between any two points on a given topographic map using the bar scale and string.**
10. **Define elevation.**
11. **Define contour line.**
12. **Define contour interval.**
13. **List the two most common contour intervals in use on 1:24,000 scale maps.**
14. **Define index contour.**
15. **Label slopes as steep or gradual using contour lines on a topographic map.**
16. **Write three principal rules about contour lines.**
17. **Determine approximate elevation of a mountain peak or hilltop using contour lines.**
18. **Draw a topographic profile between any two points on a topographic map.**
19. **Label topographic features on a topographic map (as mountains, hills, valley, depression).**

Once topographic map symbols are learned, the topographic map can be read. Good map reading skills are developed with time and patience. Like learning to drive a car, at first the operator lacks confidence and is slow and clumsy. After a period of practice, the operator soon becomes skillful and confident and is able to meet his/her responsibility for safe driving.

One can also think of the map reader as an operator who can be a threat to others. Imagine a person leading a group on a trip in a wilderness area. If the group becomes lost, their lives depend on the map reader's skills. Therefore, topographic map-reading skills should be practiced for some time before heading off into the wilderness.

(From this point forward, the term "topo. map" will be used instead of topographic map or topographic quadrangle. Topo. map is the term popularly used by hikers, industrial workers, and conservationists.)

Reading directions from the topo. map

Eight principal directions are used on the topo. map. These directions are shown in figure 3–1.

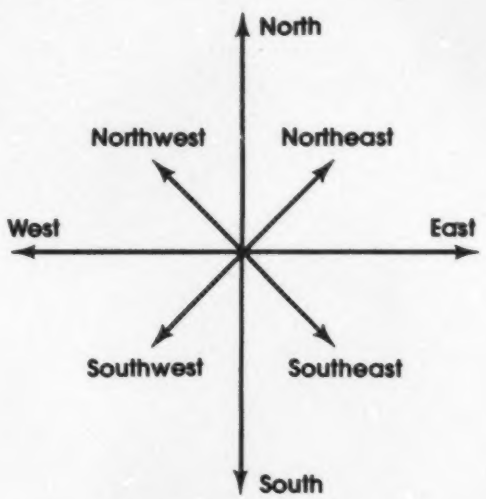


Figure 3–1. The eight principal directions.

These directions can be read directly off the topo. map. With the map placed so that the lower margin information is in an upright reading position, **north** is at the top of the map, **south** is to the bottom or lower margin, **east** is to the right-side margin, and **west** is to the left-side margin of the map. From this information, NE, SE, NW, and SW can be located very simply in their respective corners of the topographic map (see fig. 3–2).

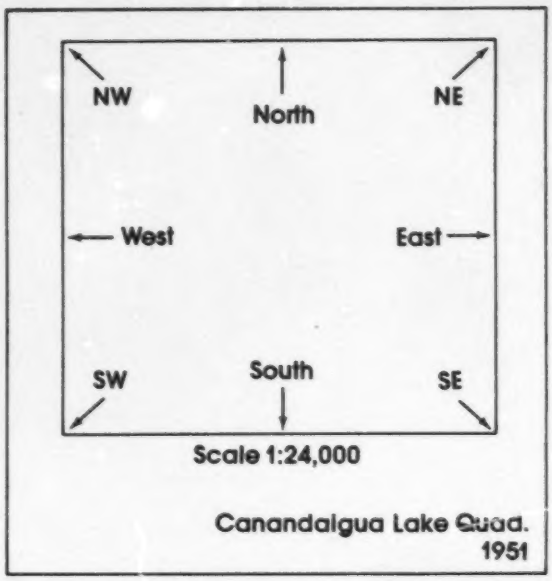


Figure 3–2. Reading the eight principal directions on a topographic map.

The map reader can identify landmarks and positions using relative directions from her/his location on the map. For example, "I am located one mile south of Canandaigua Reservoir" could be used to approximate one's position. To give a more precise location, travelers use lines of latitude and longitude.

Latitude and longitude

To locate your position in a town or city, you need a reference system. For example, a person might say "Meet me at the corner of Main Street and Maple Avenue at four o'clock" (see fig. 3–3).

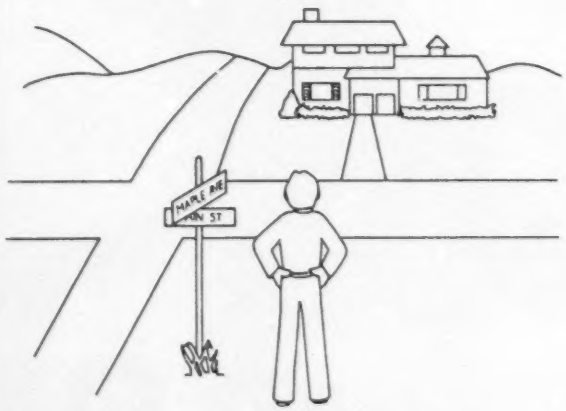


Figure 3–3. Using the grid system of city streets to locate a position.

As long as there is only one Main Street and one Maple Avenue in the town, this description of a location is accurate.

Lines of latitude and longitude are used in a way similar to streets of a town. Latitude lines run east to west and longitude lines run north to south, forming a grid system on the earth's surface (see fig. 3–4).

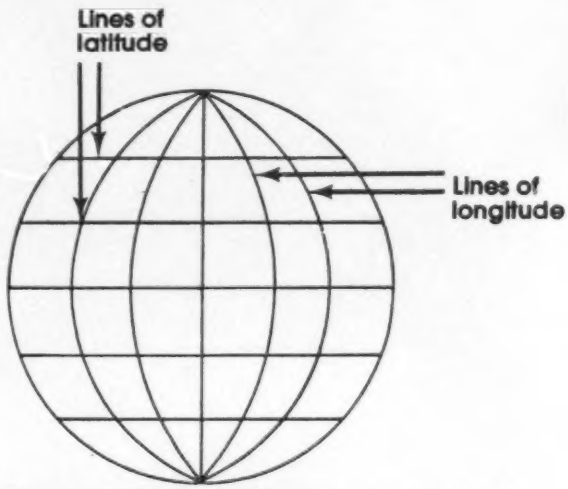


Figure 3–4. The earth's grid system: lines of latitude and longitude.

The prime meridian is the starting point for all lines of longitude. It is the 0° longitude line (see fig. 3–5). Lines of longitude measure degrees up to 180° east or west of the prime meridian. The 180° longitude line is called the international date line.

The equator is the starting point for all lines of latitude. It is the 0° latitude line. Lines of latitude measure up to 90° north and south of the equator. The polar axis points (poles) of the earth are located at 90° north and 90° south of the equator (see fig. 3–6).

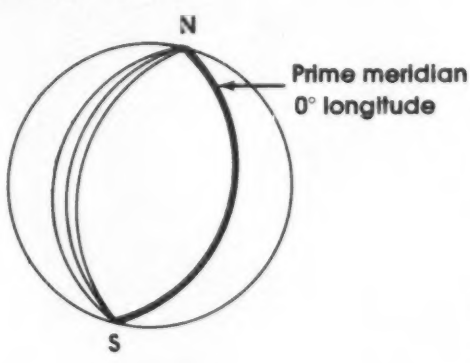


Figure 3–5. Measuring degrees of longitude starting at the prime meridian.

12

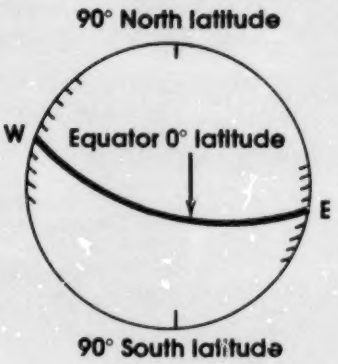


Figure 3–6. Measuring degrees of latitude starting at the equator.

To locate a town or even a large city on the globe would be impossible. It would only be a pinpoint, lost in the area between the lines of longitude and latitude. So that a position can be stated exactly, the degrees of latitude and longitude are divided into even smaller units.

The earth is a huge sphere that can be viewed as a circle divided up into 360 units called degrees (see fig. 3–7a). The symbol for degrees is °. Each degree is divided into sixty units called minutes. The symbol for minutes is Each minute is divided further into sixty units called seconds. The symbol for seconds is " (see fig. 3–7b).

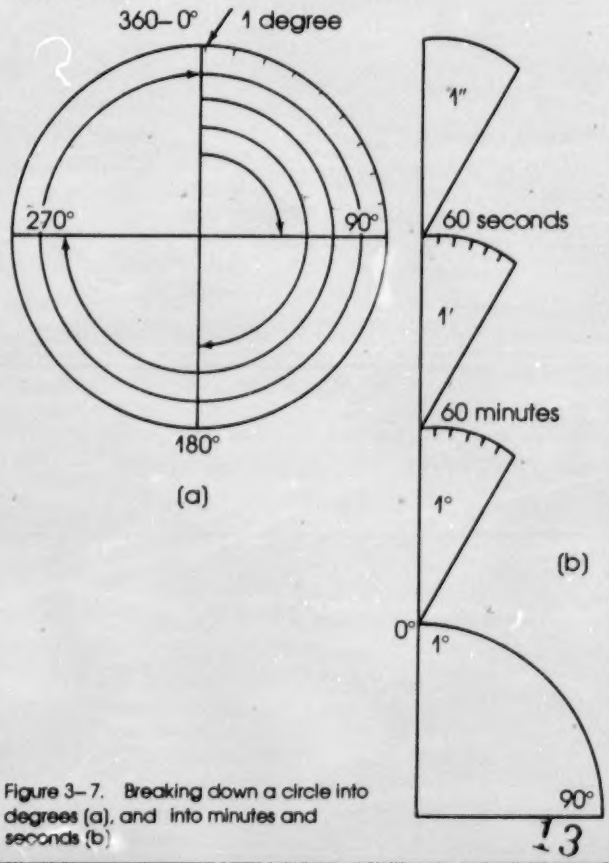


Figure 3–7. Breaking down a circle into degrees (a), and into minutes and seconds (b).

Using the subdivisions of the degree (that is, minutes and seconds), a position on the earth's surface can be located with great accuracy. For example, the Canandaigua Lake Quadrangle is located between the 77° 15′ 0″ and the 77° 22′ 30″ west longitude lines and the 42° 45′ 0″ and the 42° 52′ 30″ north latitude lines. No other location in the world can be described by these latitude and longitude numbers (see fig. 3–8).

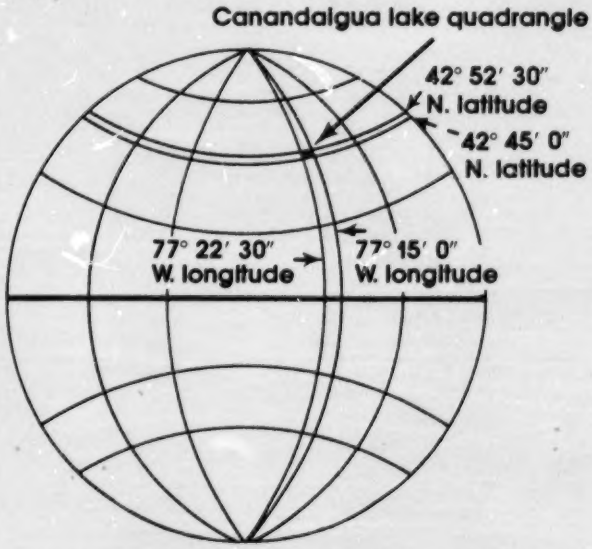


Fig. 3–8. Locating Canandaigua Lake Quadrangle with the latitude and longitude grid system.

Since the latitude and longitude grid system is used to locate a position on the earth's surface, topo. maps give the data that corresponds to the earth's grid system. The latitude and longitude of a topo. map are noted in its NE, SE, NW, and SW corners.

The topo. maps most commonly used in outdoor activities are the 7.5-minute series and the 15-minute series. These series numbers refer to the amount of land area covered by the map in parts of a degree. Look at Canandaigua Lake Quadrangle shown in figure 3–8. It is of the 7.5-minute series (77° 22′ 30″ minus 77° 15′ 0″). A map of the 15-minute series would represent a much larger land area.

In figure 3–8 showing lines of latitude and longitude on the earth's surface, it can be seen that lines of longitude meet at the earth's poles. This means that topo. quadrangles are not perfectly square in shape (see fig. 3–9). On topographic quadrangles located north of the equator, the southern border is actually longer than the northern border.

On topographic quadrangles located south of the equator, the reverse situation is true. The northern border is longer than the southern border on those maps. This means that topographic quadrangles located **nearer** to the equator cover a larger land area than those further from the equator (see shaded areas in fig. 3–9).

Figure 3–9. Shape of topographic quadrangles is not perfectly square because lines of longitude converge at the poles.

Measuring distances from the topo. map

Map scale is the amount that ground distance is reduced on a map. It is indicated by a ratio such as 1:24,000 or 1:62,000. A map scale of 1:24,000 means that 1 map unit equals 24,000 ground units. This ratio can be simplified by saying 1 inch equals 24,000 inches (2,000 ft.). Therefore, a map scale of 1:62,500 means 1 inch equals 62,500 inches (or 5,200 ft., a little less than a mile). These are the two most common topographic map scales used by people in the out-of-doors. Chart 1 describes their use.

Chart 1. Uses for map scales.

Scale	1:24,000 (7.5-min series)	1:62,500 (15-min series)
Land area represented	50–70 sq. miles	200–270 sq. miles
Uses	Travel in 4-mile radius Clear details best for orienteering	Extensive traveling in an area Advanced orienteering

Distance is measured on the topo. map by using the bar scales. The bar scale is a ruler printed on the map from which distances on the map may be calculated as actual ground distances. To the right of zero, the bar scale is marked in full units. This is called the **primary scale.** To the left of zero, an **extension scale** is provided for measuring portions of a unit. Most maps have three or more bar scales, each of which measures distance in a different unit of measure, for example, miles, feet, and kilometers (see fig. 3–10).

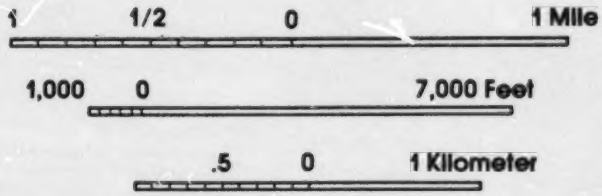


Figure 3–10. Typical bar scales.

To measure a straight-line distance between two points on a map, lay a straight-edged piece of paper on the map so that the edge of the paper touches both points. As shown in figure 3–11, make a tick mark on the edge of the paper at each point. Move the paper down to a bar scale and read the distance between the two points.

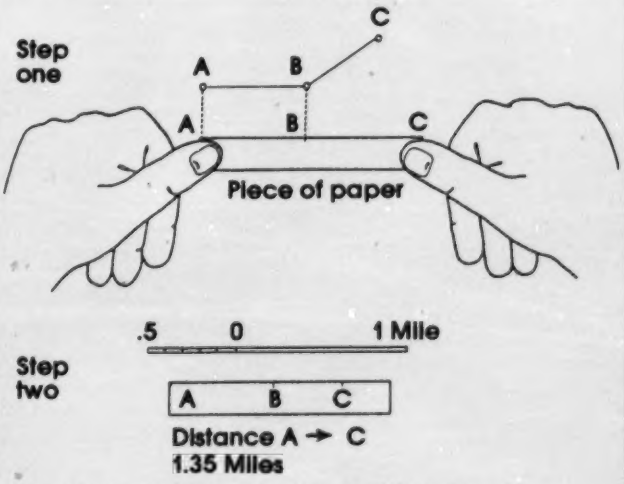


Figure 3–11. Measuring straight-line distance with paper edge.

To measure curved-line distances, such as winding roads or trails, a piece of string is a more accurate measuring tool than paper. The string is laid along the curved distance on the map, marked, then compared to a bar scale (see fig.3–12).

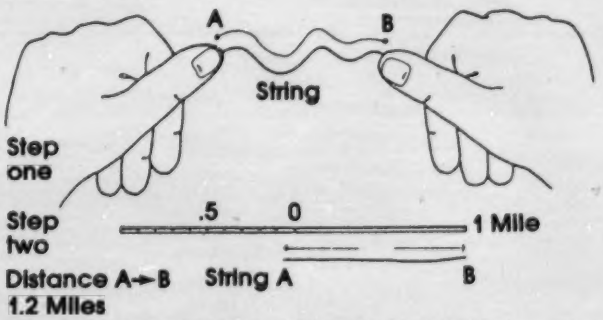


Figure 3–12. Measuring curved-line distance with string.

Using the techniques described for measuring distances on topo. maps, complete Exercise 2 on page 13.

Elevation: The shape of the land

Elevation is the height of the land above sea level. Elevation is shown on topo. maps by use of **contour lines** (brown). Each contour line represents a given elevation above sea level. All points on a contour line are at the same elevation.

The **contour interval** is the difference in elevation between adjacent contour lines. It is the same for every pair of contour lines on a map. The contour interval for each map is noted in the lower map margin below the bar scales. Contour intervals may be given as 10, 20, 50, or 100 feet. Areas with gently rolling terrain are mapped using a contour interval of 10 feet. Mountainous areas use a much larger contour interval, such as 50 or 100 feet. Use of regular intervals makes the contour lines easy to read on the map. The most common contour intervals used on 1:24,000 scale topographic maps are 10 feet and 20 feet.

Every fifth contour line is an **index contour**. It is indicated by a heavier line. Since the distance between index contours is five times the distance between contour lines, index contours represent differences in elevation of 50, 100, 250, and 500 feet (see fig. 3–13). The purpose of the index contour is to make map reading easier; therefore, the elevation of each index contour is clearly marked on the map.

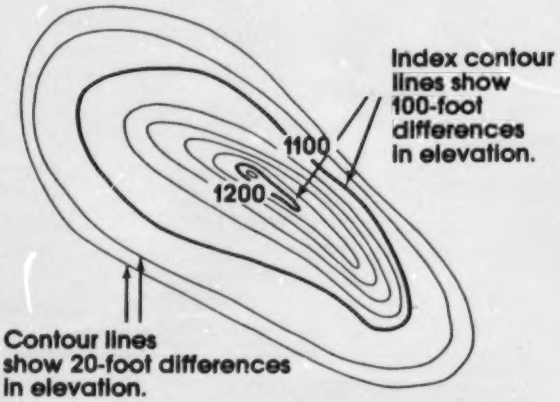


Figure 3–13. Contour lines show elevation of land.

There are three rules to remember about contour lines:

- Contour lines never cross.
- The closer together the contour lines, the steeper the slope of the land; the further apart the contour lines, the gentler the slope of the land.
- Where contour lines meet rivers and streams, they form "V's" that point upstream.

Contour lines allow the map reader to determine elevations and visualize the shape of the land (see fig. 3–14).

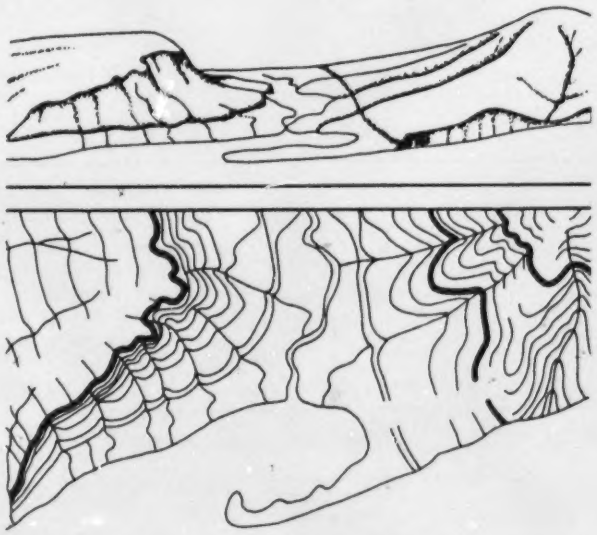


Figure 3–14. Actual site and topographic representation of it.

The elevations of mountain peaks or hilltops can be approximated by the map reader even if they are not marked on the map. The map reader notes the elevation of the index contour near the top of the peak. The reader then counts the successive contour lines to determine the highest known elevation. The exact height of the peak must lie somewhere between that elevation plus the contour interval. For example, if the last contour line drawn on a hill is 1,140 and the contour interval is 20 feet, the crest of this hill must be somewhere between 1,141 feet and 1,159 feet (see fig. 3–15). If the hilltop was 1,160 feet or higher, another contour line would have appeared on the map (as shown by the dotted line in fig. 3–15). Complete Exercise 3 on page 14.

A useful tool to help understand contour lines is the **topographic profile.** The profile (shape) of a topographic feature can be drawn by following the method shown in figure 3–16.

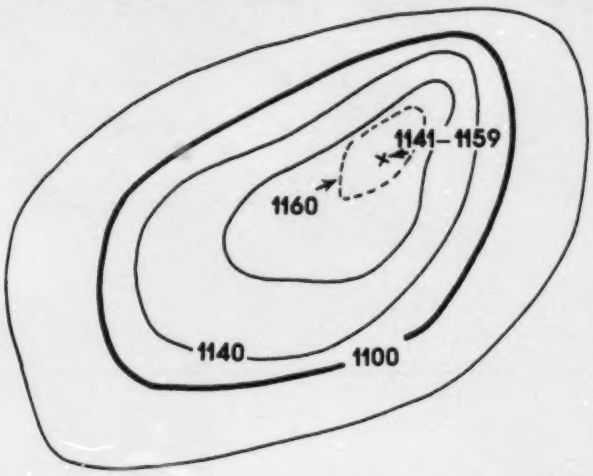


Figure 3–15. Using contour lines to determine height of peaks.

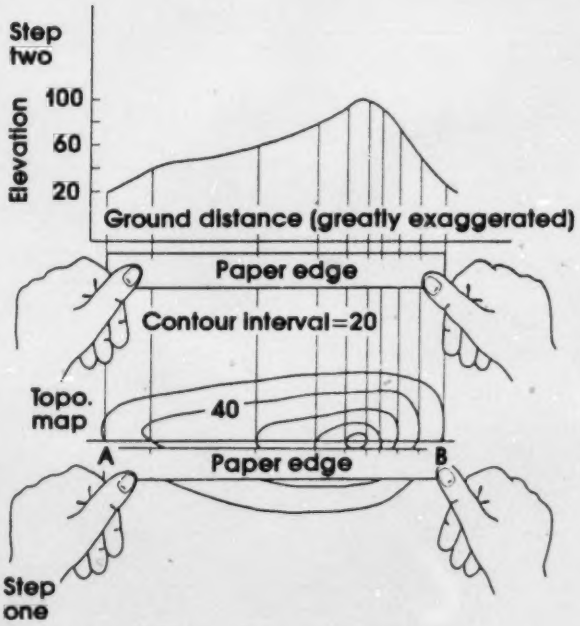


Figure 3–16. Drawing a topographic profile.

A piece of paper is used to "tick off" the elevation points along line **AB**. They are then transferred to a profile axis. The resulting picture is a profile (side view) of the land form. Complete Exercise 4 on page 15.

Depressions are shown on the topo. map by contour lines with tick marks pointing toward the center of the feature (see fig. 3–17). This marking system allows the reader to distinguish depressions from hilltops.

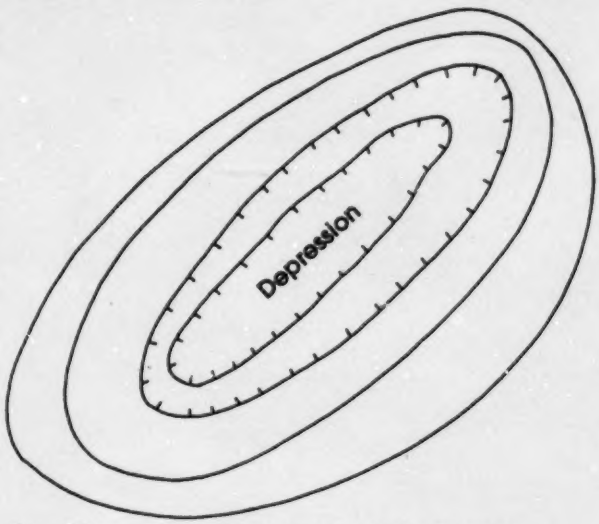


Figure 3–17. Depression contour indicated by tick marks.

You should learn seven landforms to become an effective outdoor leader. Examples of some common topographic features are shown in Figure 3–18. After studying the figure, complete Exercise 5 on page 16.

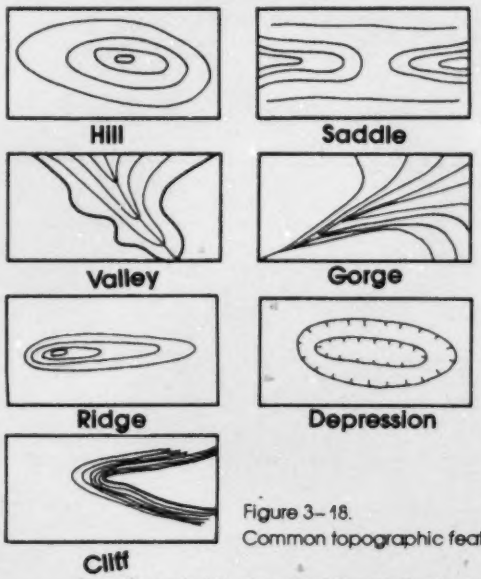


Figure 3–18. Common topographic features.

Special topographic symbols are used to identify known points of elevation. For example, **BM x 1261** is used to show the elevation and exact location of a point used in field surveys. In this case, **BM x 1261** represents a position called "Benchmark" that is 1,261 feet above sea level and located at point **X.** This location in the field may be marked with a U.S.G.S. (U.S. Geological Survey) marker labeling it as such. The markers are usually 4-foot concrete monuments with a brass identification plate. These markers are important in land surveys and must not be disturbed. Their destruction or removal may result in heavy fines for the individuals responsible.

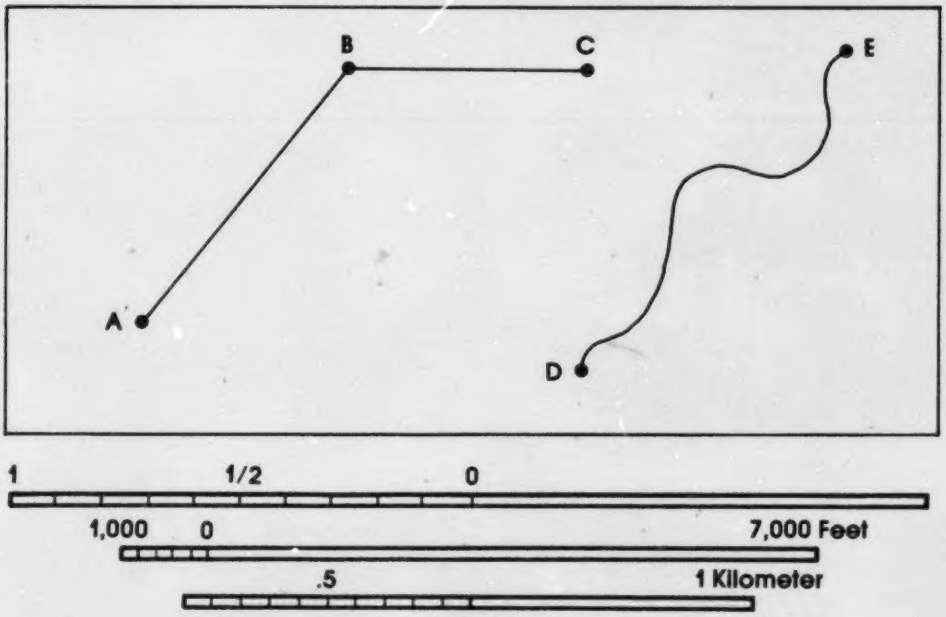
Determining distances

Name _____

Using the map and the bar scales below, measure the following distances:

Distance **A** to **C** in miles? _____
in feet? _____
in kilometers? _____

Distance **D** to **E** in miles? _____
in feet? _____
in kilometers? _____

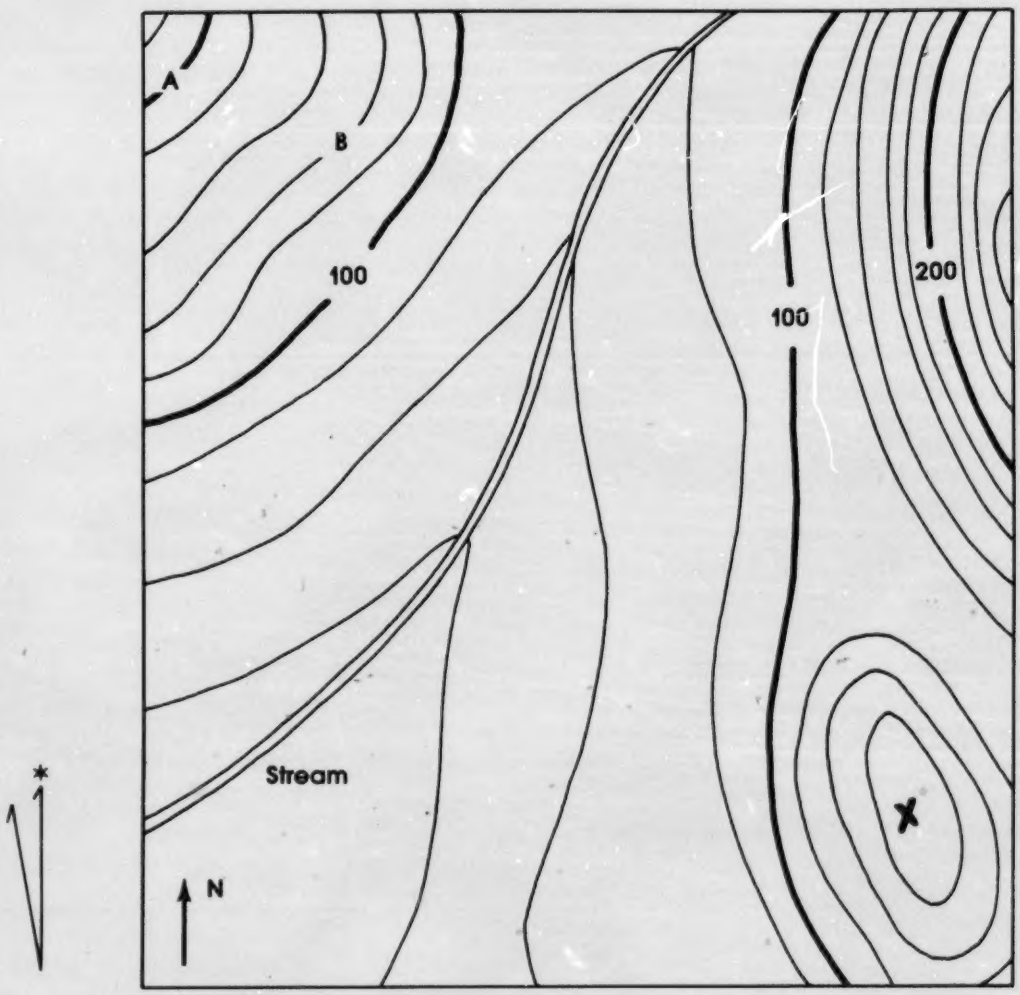


Reading a topographic map

Name _____

Using the information given on this topographic map, answer the questions below.

contour interval– 20 feet
index contour– 100



1. What is the elevation of contour line **B**? _____
2. Which hill is steeper in slope – NW corner or NE corner? Why _____
3. What is the approximate elevation of point **X** in the SE corner of the map? Between _____ ft. and _____ ft.
4. What is the major topographic feature shown on this map? _____
5. What direction is the stream flowing? _____

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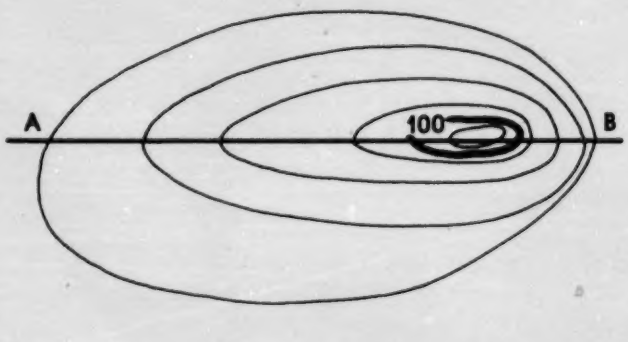
Determining topographic profiles

Name _____

Draw a topographic profile of the following landforms to answer the questions below.

Elevation

120
100
80
60
40
20

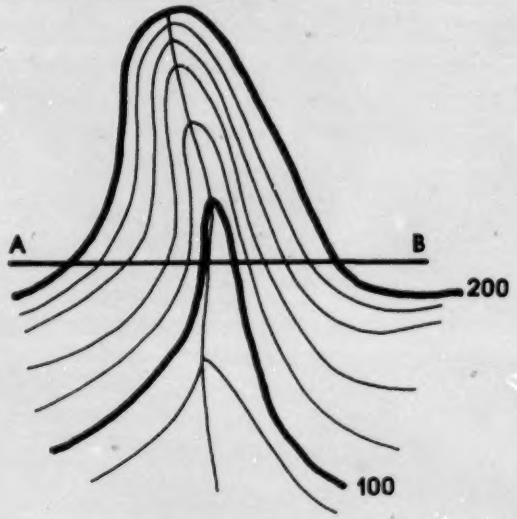


contour interval 20 feet

What is the name of this landform? _____

Elevation

200
100



contour interval 20 feet

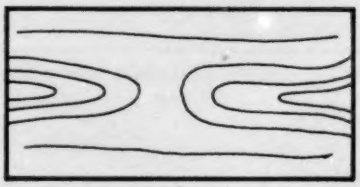
What is the name of this landform? _____

Naming topographic features

Name _____

In the space provided, write the correct name of the topographic feature shown.

1. _____

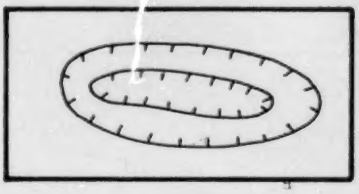


2. _____

3. _____

4. _____

5. _____



6. _____

7. _____

20

Introduction to the Orienteering Compass

At the completion of this unit, the student will be able to:

1. **Define baseline.**
2. **List the three main parts of the orienteering compass.**
3. **Draw on a sheet of paper the eight principal directions of the compass card.**
4. **Label the eight principal directions with the correct bearing in degrees.**
5. **Define bearing.**
6. **State the three main purposes of a compass.**
7. **Take a compass bearing.**
8. **Follow a compass bearing.**
9. **Travel to a specified destination and return to her/his original location using an orienteering compass.**
10. **Avoid obstacles when following a compass bearing.**

Navigating in the outdoors

All travel requires the use of some type of navigation skills. In our everyday routine, we may walk to the nearby store or drive many miles to work and school. In performing this simple travel we are using road signs and visual cues or landmarks to guide us en route. Accurate return to the starting point may depend on how well you navigated or recorded the landmarks you saw.

Navigation is the method of determining position, course, and distance traveled. When traveling on land, navigators use **landmarks** to determine their position. Some landmarks commonly used in everday life are:

City landmarks	**Rural landmarks**
stores	hilltop
school	house or cabin
roads	meadow
railroad	river
street signs	trail marker

Landmarks are important for navigating in unfamiliar territory. Careful observation of the shape of the terrain, the position of a cabin or firetower, the direction of stream flow, or the position of a mountain peak helps the reader navigate safely in an unknown area. A person who fails to observe landmarks may become disoriented, confused, and eventually lost.

Baselines often can be used when traveling in unknown territory. A baseline is an unmistakable natural feature that runs along one entire boundary of a travel area. It may be a road, a river, or a ridge that can be seen at all times. The baseline aids the outdoor traveler in determining present position and, thus, in knowing the direction and distance to a base camp. Few stream fishermen get lost because they are always beside a baseline (stream, river). The flow of water always tells them the direction to camp.

Using baselines is one of the simplest forms of outdoor navigation. If weather conditions conceal the baseline, however, the travelers must refer to a compass to find their way.

The **compass** is a device for determining directions. It has a magnetized needle that points to north. To avoid getting lost, most people carry one whenever they enter unfamiliar territory. Even in familiar territory, a compass may be needed if fog or darkness limit visibility and conceal landmarks.

The orienteering compass was designed to make it easier for the traveler to determine directions and plan travel routes. It is a combination compass, protractor, and ruler.

The orienteering compass

The modern orienteering compass has three basic parts: clear plastic base, compass housing, and magnetized needle (see fig. 4–1).

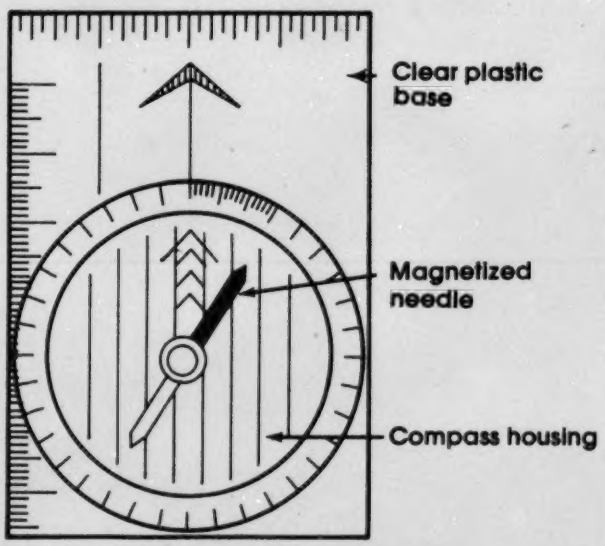


Figure 4–1. Basic parts of orienteering compass.

The **plastic base** has a direction-of-travel arrow etched on it to help you walk in a straight line and usually a ruler for measuring distances on a map. Some compasses have scales and a map magnifier on the base.

The **compass housing** consists of the compass card (the rim) and compass dial. The outer compass card is usually marked with the initials for four directions—north, east, south, and west—and 360 degrees. Note that north is located at 0° or 360°. Navigators should know the relative positions and corresponding degrees for the eight principal directions—north, northeast, east, southeast, south, southwest, west, and northwest (see fig. 4–2).

The inner part of the compass housing—the dial—is etched with a set of parallel lines. These lines are called the magnetic north lines. In Unit 5, you will see how these lines are used to line up the compass housing with a topo. map.

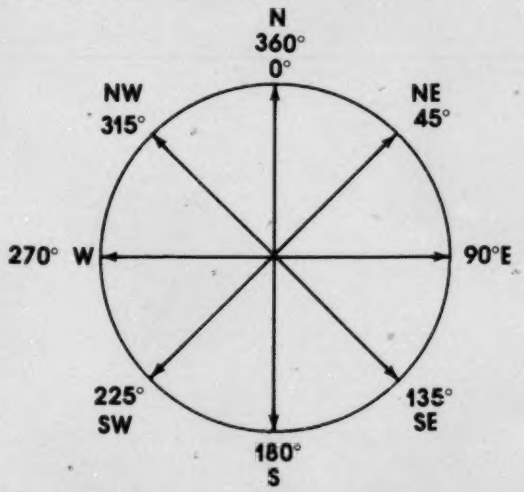


Figure 4–2. The eight principal directions and their corresponding numbers of degrees.

Swinging freely within the compass housing, the **magnetized needle** points to north.

The north end of the needle is usually painted red, but may be painted white. Read the directions provided with your compass to determine which end points to north.

Before reading further, complete Exercise 6 on page 20.

Using the orienteering compass

There are three main uses of the compass: (1) to find the direction of a destination (its bearing), (2) to follow the bearing, and (3) to return to your original location.

Steps in taking a bearing:

(1) Face the direction of your destination (or landmark).
(2) Holding the compass level, turn the compass housing until the north end of the magnetized needle points to the letter **N** on the compass card.
(3) Read the bearing (the number of degrees) on the compass card at the point where the direction-of-travel arrow touches the housing (see fig. 4–1).

Steps in following a bearing:

(1) Memorize the bearing of your destination. If possible, write it down.
(2) Walk toward your destination. If it disappears from sight, you must use your compass to reach it.
(3) Hold the compass level at waist height directly in front of your body. (Keep it away from metal objects such as belt buckles, knives, automobiles, or railroad tracks. Metal objects interfere with the needle's movement.)
(4) Orient the compass: Turn the housing so your original bearing is at the direction-of-travel arrow. Turn your body so the north end of the needle points to the letter **N.**
(5) Look out directly over the direction-of-travel arrow and pick out a landmark. Walk to it.
(6) At that spot, orient your compass and walk to the next landmark.
(7) Repeat step 6 until you reach your destination.

Steps in returning to the starting point:

To reach your destination, you followed the direction-of-travel arrow. The **back** of the compass plate was pointing to your starting point. Thus, the back of the compass plate is your guide for the return trip.

(1) Leave your compass set at the bearing for your destination.
(2) Hold the compass level with the direction-of-travel arrow pointing to you.
(3) Turn your body until the north end of the needle points to the letter **N** on the compass housing.
(4) Look straight ahead and pick out a landmark. Walk to it.
(5) At that spot, check your compass: The needle should be pointing to **N** and the direction-of-travel arrow should be pointing to you.
(6) Pick out a new landmark and walk to it.
(7) Repeat steps 5 and 6 until you reach your starting point.

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Avoiding obstacles when following a bearing

When following a bearing, hikers occasionally face an obstacle that cannot be crossed. The obstacle may be a mountain peak, steep hill, lake, stream, or swamp. Although maintaining a straight-line bearing is important, the physical risk or effort required may not be worth taking. In these cases, the hiker can follow the method shown in figure 4–3 to navigate around an obstacle and return to approximately the original bearing line.

(1) Upon reaching the obstacle, use the compass to make a 90° turn.
- Add 90 to the original bearing. (Subtract 90 to turn the opposite direction.)
- Set the compass at this new number.
- Turn your body so the magnetized needle points to the letter **N**.

(2) Walk straight ahead, counting the number of steps it takes to get by the obstacle. Remember this number.

(3) Set the compass at the original bearing and follow it until you are past the obstacle. (Remember: The needle should always be pointing to **N**.)

(4) To turn back towards the original bearing line, make another 90° turn.
- Subtract 90 from the original bearing. (If you subtracted the first time, you must add 90 this time.)
- Set the compass at this new number.
- With the needle pointing to **N**, walk straight ahead for the same number of steps you counted before. This will take you to the original bearing line.

(5) Set the compass at the original bearing and follow it to your destination.

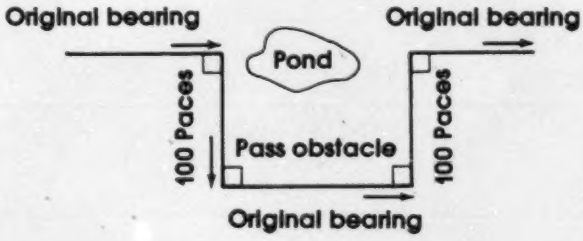
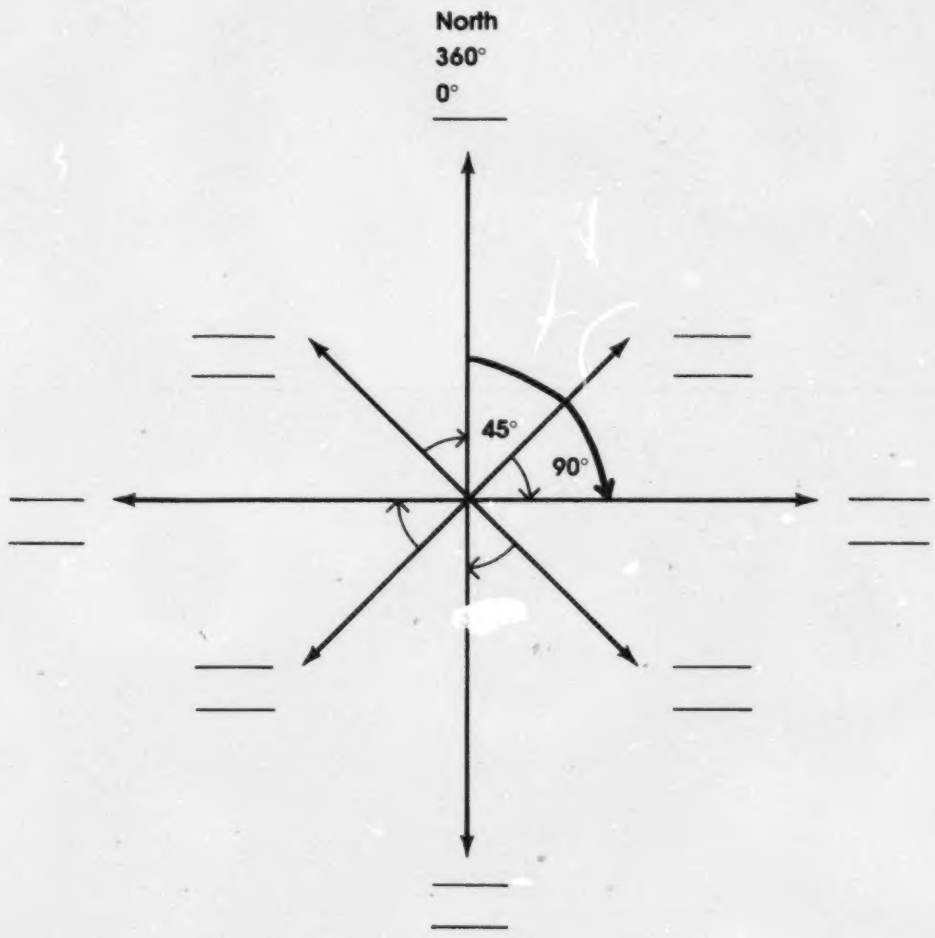


Figure 4–3. One method to get around an obstacle and back to original bearing.

Naming directions

Name _____

On the compass card below, fill in the correct direction name and the corresponding number of degrees.



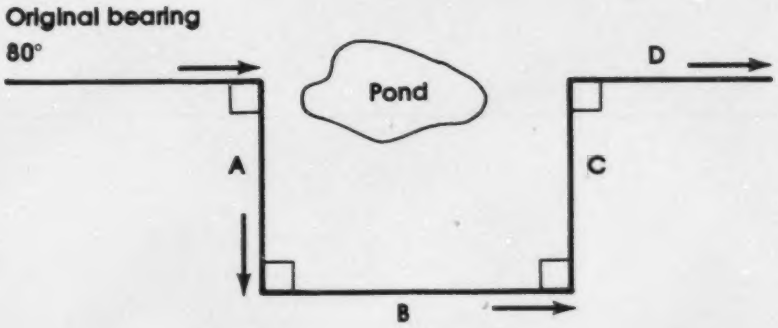
24

Avoiding obstacles

Name _____

You are traveling to a cabin following a bearing of 80° when you reach a pond. Indicate in the spaces below the bearing of points **A, B, C,** and **D.**

Position	**Bearing in degrees**
A	_____
B	_____
C	_____
D	_____



Orienteering: Traveling by Map and Compass

At the completion of this unit, the student will be able to:

1. **Define orienteering.**
2. **Define true north.**
3. **Define magnetic north.**
4. **Define magnetic declination.**
5. **State one reason why declination is important in orienteering.**
6. **Draw magnetic north lines on a topo. map at the correct angle.**
7. **Orient a topo. map to magnetic north using a compass.**
8. **Travel in unfamiliar territory using a topo. map and compass.**
9. **Locate position on a topo. map using a compass, a baseline, and an identifiable landmark.**
10. **Locate position on a topo. map using a compass and two identifiable landmarks.**

Using a map and compass to navigate is called **orienteering.** The compass orients you to north, and the topo. map shows where you are and what's ahead. Orienteering opens up new areas for safe travel and exploration.

True north and magnetic north

As you recall from Unit 3, the upper edge of a topo. map is always north, called **map north.** Navigators refer to this direction as true north. True north is found by following lines of longitude to the north pole, the center of the earth's rotation. All maps indicate this direction.

The north end of the magnetized compass needle points to magnetic north, not true north. The earth is a huge spinning ball. Its turning motion causes a magnetic field to be produced from the movement of molten metals deep beneath its crust. This magnetic field forms a specific pattern around the earth, like magnetic lines around a magnet (see fig. 5–1). Compass needles always line up with this magnetic field, which goes from the north **magnetic** pole to the south **magnetic** pole.

The north magnetic pole is located near Greenland, about 1,000 miles from the north pole. Therefore, magnetic north does not line up exactly with true north. The difference between true north and magnetic north is called the **magnetic declination** angle. In the U.S., declinations range from 0° to 30°, and can be either east or west of true north (see fig. 5–2).

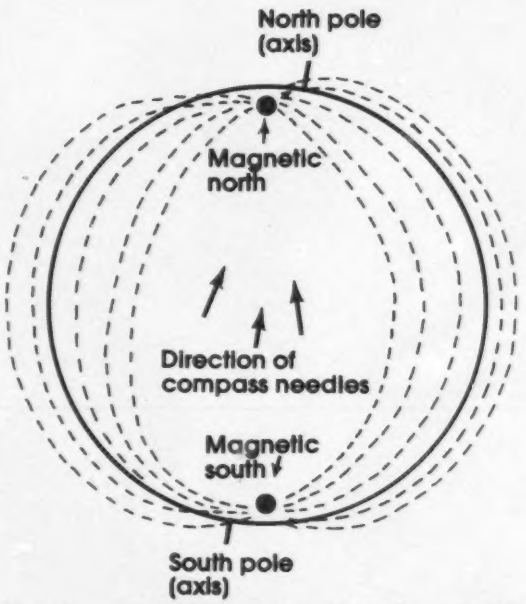


Figure 5–1. The magnetic lines caused by the earth rotating on its axis. Note that the compass needle will point to magnetic north.

When navigating with a map and compass, you must note the magnetic declination angle. Most topo. maps will give it in the lower margin. **MN** represents magnetic north and * or **TN** represents true north. If you ignore the difference in bearing between true north and magnetic north and just follow the compass, you could get lost. For example, if the magnetic declination on a topo. map is 9° and this is ignored when taking bearings, you may arrive 800 feet to one side of the destination after only one mile of hiking!

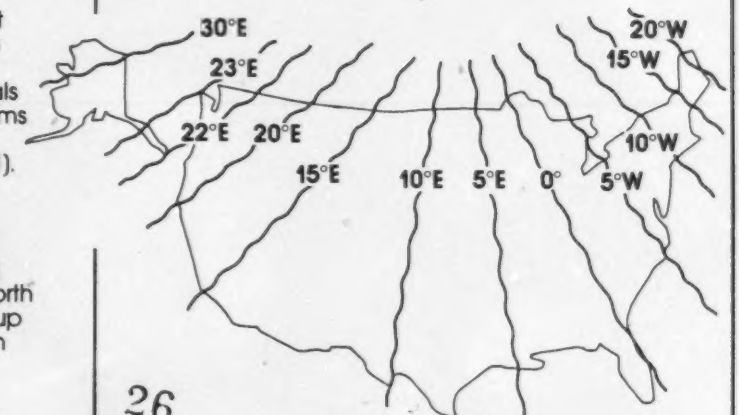


Figure 5–2. Lines of magnetic declination.

To make sure you allow for the difference between magnetic north and true north, draw magnetic north lines on topo. maps at the time of purchase. These lines are a great aid in taking bearings in the field. Follow these steps:

(1) Find the declination diagram in the map's lower left-hand margin.
(2) Place a ruler or straightedge along the magnetic declination line (noted by **MN**).
(3) Extend the declination line across the entire map using a black pen or felt-tipped marker.
(4) Using the width of the ruler as a guide, draw parallel lines across the entire map as shown in figure 5–3.

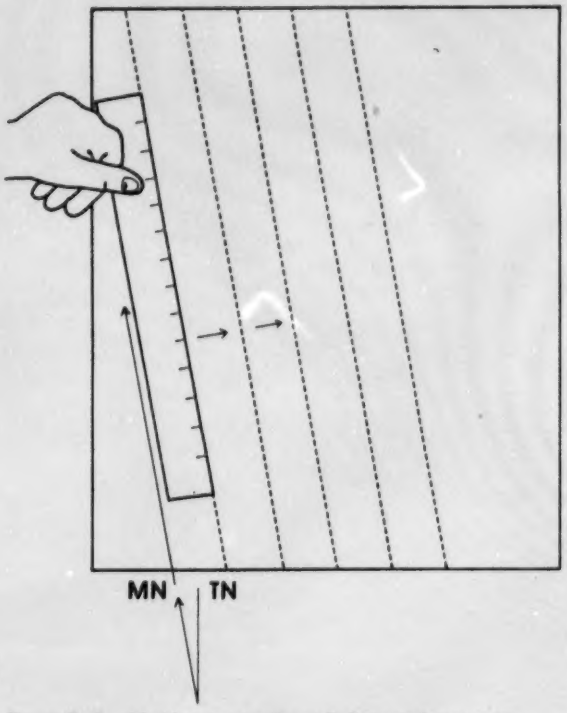


Figure 5–3. Marking magnetic north lines on topo. map.

Orienting the map

It is important to **orient** (line-up) the map to magnetic north to see the landmarks around you in their respective map and ground locations. To do this, use the map's magnetic north lines (see fig. 5–4).

(1) Set the compass at 0° (360°).
(2) Lay the compass with its edge along one of the magnetic north lines.
(3) Rotate the map and the compass together until the north end of the needle points to the **N** of the compass.

The map is now oriented to magnetic north. Now you should be able to identify topographic features and symbols on the map and on the ground.

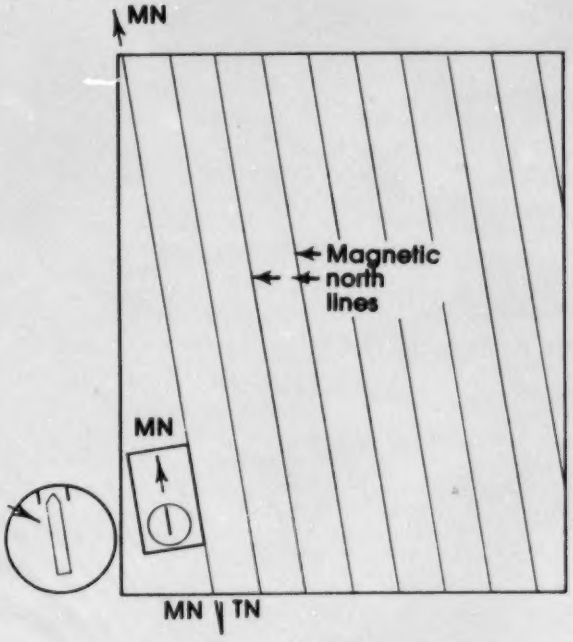


Figure 5–4. Orienting the map using the magnetic north lines.

With a topographic map correctly oriented as in figure 5–5, one can see that if a hiker is located at point X and facing north, there is a hill located to the left, railroad tracks to the right, a pond directly behind, and a major highway directly ahead.

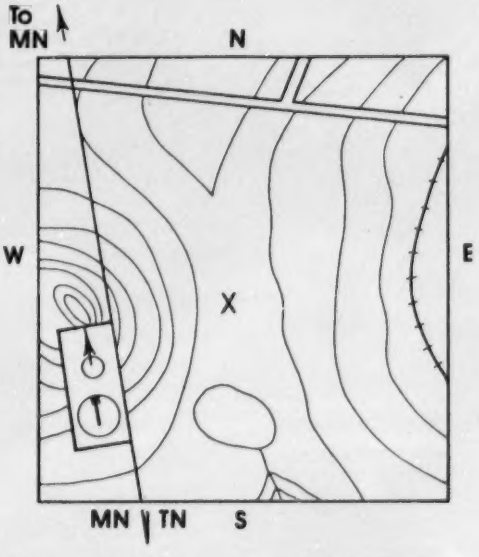


Figure 5–5. Orienting the map to find what features are ahead.

Four steps in orienteering

To travel with a topo. map and compass, follow these four steps (see fig. 5–6).

Step 1. **On the map, place the compass with its edge along the desired line of travel.** The direction-of-travel arrow should point toward your destination.

Step 2. **Turn the compass housing so that the magnetic north lines of the compass lie parallel with the magnetic north lines of the map.** Disregard the compass needle.

Step 3. **Read the bearing at the correct place.** This number represents the direction to your destination.

Step 4. **Follow the bearing set on your compass.** Holding the compass level at waist height, turn your body until the needle points to N on the compass housing. The direction-of-travel arrow points to your destination. Proceed to your destination following the steps outlined in Unit 4, page 18.

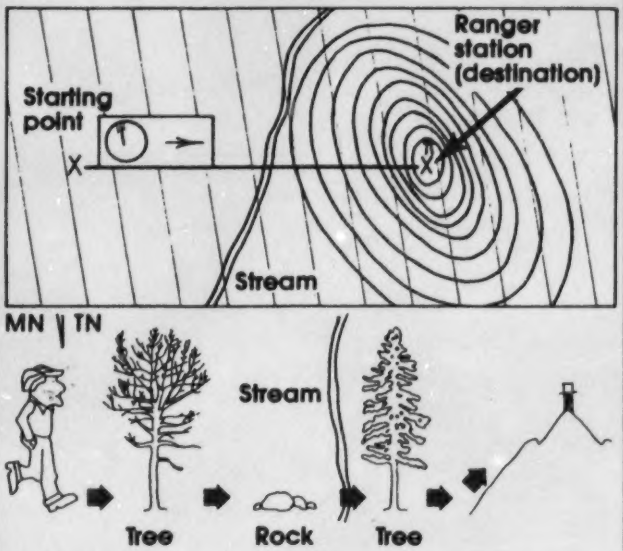


Figure 5–6. (a) Taking a bearing from a topographic map, and (b) following a bearing by use of sightings and checkpoints.

Accurate sighting is essential for walking a straight line to your destination. If you tend to stray off the line by two to three feet with each sighting, it is quite possible that the destination will be missed, especially over a long distance.

When hiking with a compass and topo. map, you should note the terrain shown on the map. The hiker in figure 5–6 should note that the intended path of travel crosses a stream, then begins an upward climb to the firetower at the top of the hill. If the hiker encounters anything different, such as a downward slope after crossing the stream or no stream at all, it would be wise to turn around and return to the starting point. This can be done by adding 180° to the bearing shown on the compass, then following that new bearing back to the starting point. This is a form of **backsighting.**

Backsighting is a technique used to check the accuracy of one's bearing. To backsight, add 180° to the bearing and sight back toward a previous checkpoint (landmark). If an accurate bearing is followed, the backsighting will point directly to the previous checkpoint. Some outdoor travelers take a backsighting for every checkpoint they use. This assures that an accurate bearing will be followed.

To practice taking accurate bearings on a topo. map, complete Exercise 8 on page 27.

Using baseline and landmarks to locate position

At times you may not know your position on a topo. map. By positioning yourself on a baseline and locating an identifiable landmark, your position can be located (see fig. 5–7).

(1) Orient the map to magnetic north using the compass. (Review procedure on page 24).
(2) Look for a landmark in the field that is shown on the map.
(3) Take a bearing of the landmark. (Review procedure on page 18).

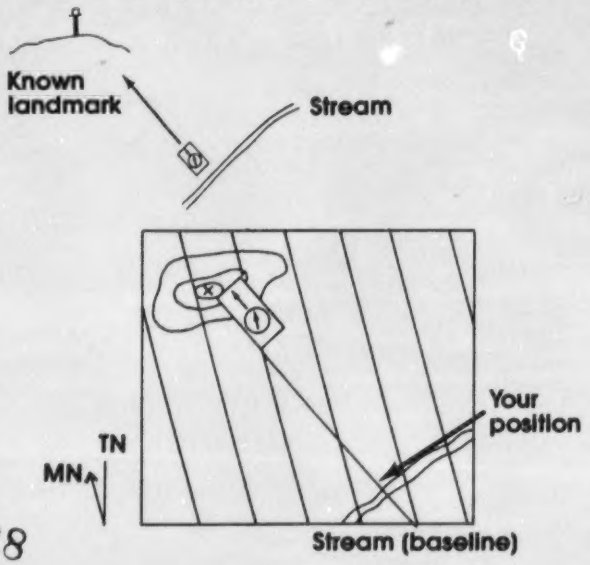


Figure 5–7. Locating position using baseline and landmark.

(4) Without changing the compass housing, place the compass on the map so (a) the edge of the compass intersects with the landmark and (b) the compass **MN** lines are parallel with the map's **MN** lines.
(5) Draw a line along the edge of the compass to the baseline. This is the bearing line.

Where the bearing line intersects the baseline is your approximate location.

Your position on a topo. map can also be located by using two identifiable landmarks. As just outlined, determine the bearings of the two landmarks and draw the bearing lines on the map. Where the two bearing lines cross is your approximate location (see fig. 5–8).

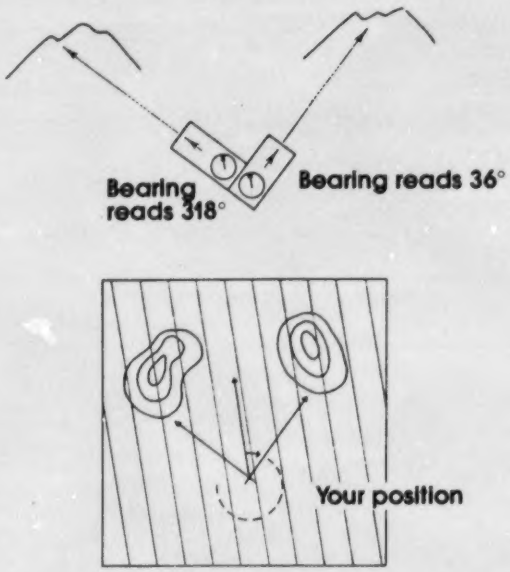


Figure 5–8. Locating position using the bearings of two landmarks.

Summary

Practice in map and compass orienteering is required in order to develop the needed confidence and skill to travel in rural and wilderness areas without getting lost. But remember, you can get lost!

Daniel Boone, perhaps the most famous of wilderness travelers, often said, "I have never been lost, only confused for a few days." To avoid getting lost or just "confused," follow these rules for your personal safety and enjoyment before heading out in a rural or wilderness area.

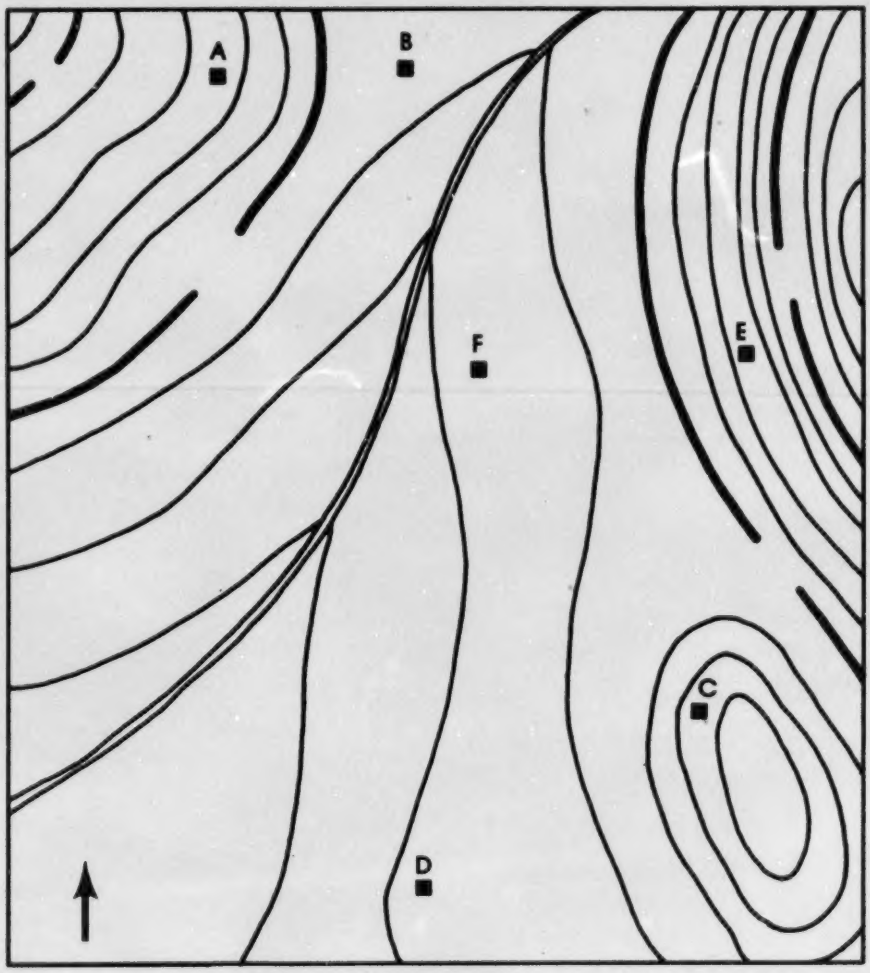
(1) Carry a map and compass and know how to use them.
(2) Leave the following information with the local forest ranger (or someone who can contact help if you do not return as scheduled):
- where are you going
- your expected route to travel
- when you expect to return

(3) Carry a first aid kit, adequate provisions, and clothing.
(4) **Never travel alone** in unfamiliar territory.

Taking bearings on a topo. map

Using an orienteering compass, a ruler, and the topographic map below, write the correct bearings in the space provided.

1. from A to B _____
2. from B to C _____
3. from C to D _____
4. from D to E _____
5. from E to F _____



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TOPOGRAPHIC MAP SYMBOLS

VARIATIONS WILL BE FOUND ON OLDER MAPS

- Primary highway, hard surface
- Secondary highway, hard surface
- Light-duty road, hard or improved surface
- Unimproved road
- Road under construction, alinement known
- Proposed road
- Dual highway, dividing strip 25 feet or less
- Dual highway, dividing strip exceeding 25 feet
- Trail

- Railroad: single track and multiple track
- Railroads in juxtaposition
- Narrow gage: single track and multiple track
- Railroad in street and carline
- Bridge: road and railroad
- Drawbridge: road and railroad
- Footbridge
- Tunnel: road and railroad
- Overpass and underpass
- Small masonry or concrete dam
- Dam with lock
- Dam with road
- Canal with lock

- Buildings (dwelling, place of employment, etc.)
- School, church, and cemetery — Cem
- Buildings (barn, warehouse, etc.)
- Power transmission line with located metal tower
- Telephone line, pipeline, etc. (labeled as to type)
- Wells other than water (labeled as to type) — Oil — Gas
- Tanks: oil, water, etc. (labeled only if water) — Water
- Located or landmark object; windmill
- Open pit, mine, or quarry; prospect
- Shaft and tunnel entrance

Horizontal and vertical control station:

- Tablet, spirit level elevation — BM △5653
- Other recoverable mark, spirit level elevation — △5455

Horizontal control station: tablet, vertical angle elevation — VABM △95/9

- Any recoverable mark, vertical angle or checked elevation — △3775

Vertical control station: tablet, spirit level elevation — BM × 957

- Other recoverable mark, spirit level elevation — × 954

Spot elevation — 31 × 7369 × 7369

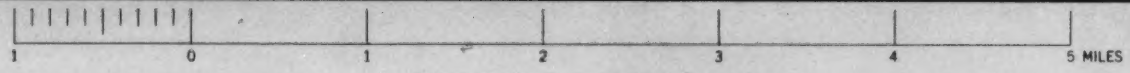
Water elevation — 670 670

- Boundaries: National
- State
- County, parish, municipio
- Civil township, precinct, town, barrio
- Incorporated city, village, town, hamlet
- Reservation, National or State
- Small park, cemetery, airport, etc.
- Land grant
- Township or range line, United States land survey
- Township or range line, approximate location
- Section line, United States land survey
- Section line, approximate location
- Township line, not United States land survey
- Section line, not United States land survey
- Found corner: section and closing
- Boundary monument: land grant and other
- Fence or field line

- Index contour
- Supplementary contour
- Fill
- Levee
- Mine dump
- Tailings
- Shifting sand or dunes
- Sand area
- Intermediate contour
- Depression contours
- Cut
- Levee with road
- Wash
- Tailings pond
- Intricate surface
- Gravel beach

- Perennial streams
- Elevated aqueduct
- Water well and spring
- Small rapids
- Large rapids
- Intermittent lake
- Foreshore flat
- Sounding, depth curve — 10
- Exposed wreck
- Intermittent streams
- Aqueduct tunnel
- Glacier
- Small falls
- Large falls
- Dry lake bed
- Rock or coral reef
- Piling or dolphin
- Sunken wreck
- Rock, bare or awash; dangerous to navigation

- Marsh (swamp)
- Wooded marsh
- Woods or brushwood
- Vineyard
- Land subject to controlled inundation
- Submerged marsh
- Mangrove
- Orchard
- Scrub
- Urban area



MILE SCALE 1:62 500

UNITED STATES DEPARTMENT OF THE INTERIOR GEOLOGICAL SURVEY

TOPOGRAPHIC MAP INFORMATION AND SYMBOLS MARCH 1978

QUADRANGLE MAPS AND SERIES

Quadrangle maps cover four-sided areas bounded by parallels of latitude and meridians of longitude. Quadrangle size is given in minutes or degrees.

Map series are groups of maps that conform to established specifications for size, scale, content, and other elements.

Map scale is the relationship between distance on a map and the corresponding distance on the ground.

Map scale is expressed as a numerical ratio and shown graphically by bar scales marked in feet, miles, and kilometers.

NATIONAL TOPOGRAPHIC MAPS

Series	Scale	1 inch represents	1 centimeter represents	Standard quadrangle size (latitude-longitude)	Quadrangle area (square miles)
7½-minute	1:24,000	2,000 feet	240 meters	7½×7½ min.	49 to 70
7½×15-minute	1:25,000	about 2,083 feet	250 meters	7½×15 min.	98 to 140
Puerto Rico 7½-minute	1:20,000	about 1,667 feet	200 meters	7½×7½ min.	71
15-minute	1:62,500	nearly 1 mile	625 meters	15×15 min.	197 to 282
Alaska 1:63,360	1:63,360	1 mile	nearly 634 meters	15×20 to 36 min.	207 to 281
Intermediate	1:100,000	nearly 1.6 miles	1 kilometer	30×60 min.	1568 to 2240
U. S. 1:250,000	1:250,000	nearly 4 miles	2.5 kilometers	1°×2° or 3°	4,580 to 8,669
U. S. 1:1,000,000	1:1,000,000	nearly 16 miles	10 kilometers	4°×6°	73,734 to 102,759
Antarctica 1:250,000	1:250,000	nearly 4 miles	2.5 kilometers	1°×3° to 15°	4,089 to 8,336
Antarctica 1:500,000	1:500,000	nearly 8 miles	5 kilometers	2°×7½°	28,174 to 30,462

CONTOUR LINES SHOW LAND SHAPES AND ELEVATION

The shape of the land, portrayed by contours, is the distinctive characteristic of topographic maps.

Contours are imaginary lines following the ground surface at a constant elevation above or below sea level.

Contour interval is the elevation difference represented by adjacent contour lines on maps.

Contour intervals depend on ground slope and map scale. Small contour intervals are used for flat areas; larger intervals are used for mountainous terrain.

Supplementary dotted contours, at less than the regular interval, are used in selected flat areas.

Index contours are heavier than others and most have elevation figures.

Relief shading, an overprint giving a three-dimensional impression, is used on selected maps.

Orthophotomaps, which depict terrain and other map features by color-enhanced photographic images, are available for selected areas.

COLORS DISTINGUISH KINDS OF MAP FEATURES

Black is used for manmade or cultural features, such as roads, buildings, names, and boundaries.

Blue is used for water or hydrographic features, such as lakes, rivers, canals, glaciers, and swamps.

Brown is used for relief or hypsographic features—land shapes portrayed by contour lines.

Green is used for woodland cover, with patterns to show scrub, vineyards, or orchards.

Red emphasizes important roads and is used to show public land subdivision lines, land grants, and fence and field lines.

Red tint indicates urban areas, in which only landmark buildings are shown.

Purple is used to show office revision from aerial photographs. The changes are not field checked.

INDEXES SHOW PUBLISHED TOPOGRAPHIC MAPS

Indexes for each State, Puerto Rico and the Virgin Islands of the United States, Guam, American Samoa, and Antarctica show available published maps. Index maps show quadrangle location, name, and survey date. Listed also are special maps and sheets, with prices, map dealers, Federal distribution centers, and map reference libraries, and instructions for ordering maps. Indexes and a booklet describing topographic maps are available free on request.

HOW MAPS CAN BE OBTAINED

Mail orders for maps of areas east of the Mississippi River, including Minnesota, Puerto Rico, the Virgin Islands of the United States, and Antarctica should be addressed to the Branch of Distribution, U. S. Geological Survey, 1200 South Eads Street, Arlington, Virginia 22202. Maps of areas west of the Mississippi River, including Alaska, Hawaii, Louisiana, American Samoa, and Guam should be ordered from the Branch of Distribution, U. S. Geological Survey, Box 25286, Federal Center, Denver, Colorado 80225. A single order combining both eastern and western maps may be placed with either office. Residents of Alaska may order Alaska maps or an index for Alaska from the Distribution Section, U. S. Geological Survey, Federal Building-Box 12, 101 Twelfth Avenue, Fairbanks, Alaska 99701. Order by map name, State, and series. On an order amounting to $300 or more at the list price, a 30-percent discount is allowed. No other discount is applicable. Prepayment is required and must accompany each order. Payment may be made by money order or check payable to the U. S. Geological Survey. Your ZIP code is required.

Sales counters are maintained in the following U. S. Geological Survey offices, where maps of the area may be purchased in person: 1200 South Eads Street, Arlington, Va.; Room 1028, General Services Administration Building, 19th & F Streets NW, Washington, D. C.; 1400 Independence Road, Rolla, Mo.; 345 Middlefield Road, Menlo Park, Calif.; Room 7638, Federal Building, 300 North Los Angeles Street, Los Angeles, Calif.; Room 504, Custom House, 555 Battery Street, San Francisco, Calif.; Building 41, Federal Center, Denver, Colo.; Room 1012, Federal Building, 1961 Stout Street, Denver Colo.; Room 1C45, Federal Building, 1100 Commerce Street, Dallas, Texas; Room 8105, Federal Building, 125 South State Street, Salt Lake City, Utah; Room 1C402, National Center, 12201 Sunrise Valley Drive, Reston, Va.; Room 678, U. S. Court House, West 920 Riverside Avenue, Spokane, Wash.; Room 108, Skyline Building, 508 Second Avenue, Anchorage, Alaska; and Federal Building, 101 Twelfth Avenue, Fairbanks, Alaska.

Commercial dealers sell U. S. Geological Survey maps at their own prices. Names and addresses of dealers are listed in each State index.

INTERIOR—GEOLOGICAL SURVEY RESTON, VIRGINIA—1978